PETROLOGIC AND CHEMICAL CHARACTERIZATION OF A SUITE OF ANTARCTIC DIOGENITES.

D. W. Mittlefehldt[1], S. A. Mertzman[2], Z. X. Peng[3] and K. R. Mertzman[2]. [1]NASA/Johnson Space Center, Houston, TX, USA. E-mail: david.w.mittlefehldt@nasa.gov. [2]Franklin & Marshall College, Lancaster, PA, USA. [3]Engineering and Science Contract Group, Houston, TX, USA.

Introduction: The origin of diogenites, ultramafic cumulates related to eucrites, is an unresolved problem [1]. Most diogenites are orthopyroxenites, a few are harzburgites [2], and some are transitional to cumulate eucrites [1, 3]. Cumulate eucrites are gabbros formed by crystal fractionation from basaltic eucrites [4]. The consensus view is that basaltic eucrites are residual melts from global-magma-ocean crystallization on their parent asteroid [4] which is plausibly Vesta [5]. However, the petrologic and compositional characteristics of diogenites seem to preclude a magma ocean origin [1, 4]. We are doing a petrologic and chemical study of new or unusual diogenites with the ultimate goals of constraining their genesis, and the geologic evolution of Vesta.

Petrology: Our petrologic studies are on-going; highlights are given here. Four diogenites, MIL 07613, MIL 090105, MIL 090106 and MIL 090107 are proposed to be paired, are plagioclase-bearing and contain atypically ferroan low-Ca pyroxenes. MIL 07613 has low-Ca pyroxene with mg# [molar 100*(MgO/(MgO+FeO))] of 62.4 vs. 70-77 typical of diogenites [1, 6]. MIL 07613 is more ferroan than Yamato Type B diogenites that are transitional to cumulate eucrites [1, 3]. The MIL 09010n diogenites all have very similar low-Ca pyroxenes with mg# of ~68.8, substantially more magnesian than those in MIL 07613. MIL 090106 additionally contains a suite of more ferroan pyroxenes with compositions like those of cumulate eucrites; $Wo_{7.6}En_{47.7}Fs_{44.7}$. These pyroxenes have yet to be found in MIL 090105 or MIL 090107.

Composition: Samples massing 2.0 to 2.7 grams were homogenized and split for XRF and ICP-MS analyses. Only the XRF analyses have been completed. Bulk rock mg# varies from 83.2 (MET 00425) to 64.4 (the MIL 09010n diogenites). Excluding the latter, the lowest bulk rock mg# is 68.6 for MET 00436. Harzburgitic diogenite MIL 07001 has a mg# of 75.1, within the range typical of orthopyroxenitic diogenites. The Al and Ca contents of the MIL 09010n diogenites suggest they may contain sufficient mafic material to be classified as howardites rather than polymict diogenites. Excluding MIL 09010n, Ti and Ca contents are correlated with Al, although MIL 07001 falls below the Ti-Al trend. As noted for diogenites [6], Al, Ca and Ti do not show igneous trends of increasing concentration with decreasing mg#. The most magnesian (MET 00425) and most ferroan (MET 00436) have the lowest Al, Ti and Ca contents.

Summary: MIL 07613 is a cumulate intermediate between typical diogenites and cumulate eucrites. We think it likely that: (i) the MIL 09010n diogenites are paired; (ii) they are polymict breccias, possibly howardites; (iii) they may not be paired with MIL 07613.

References: [1] Mittlefehldt D. W. et al. 2012. *Meteoritics & Planetary Science* 47:72. [2] Beck A. W. & McSween H. Y. 2010. *Meteoritics & Planetary Science* 45:850. [3] Yamaguchi A. et al. 2009. Abstract #1547. 40th Lunar and Planetary Science Conference. [4] McSween H. Y. et al. 2011. *Space Science Reviews* 163:141. [5] McSween H. Y. et al. 2013. *Meteoritics & Planetary Science* 48, in press. [6] Mittlefehldt D. W. 1994. *Geochimica et Cosmochimica Acta* 58:1537.